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(54) Abstract Title
Endoscope with array of light sources

(57) An endoscope (1) includes a shaft (2) through which an image guide (3) and a light guide (7), comprising a bundle of optical fibres, pass. An illumination device has a flat array (11) of discrete light sources (14) and is arranged to illuminate the proximal end (9) of the light guide. A condensor can also be included to focus the light from the array (11) of light sources onto the proximal end (9) of the light guide (7). The light sources can be light emitting diodes (LED).

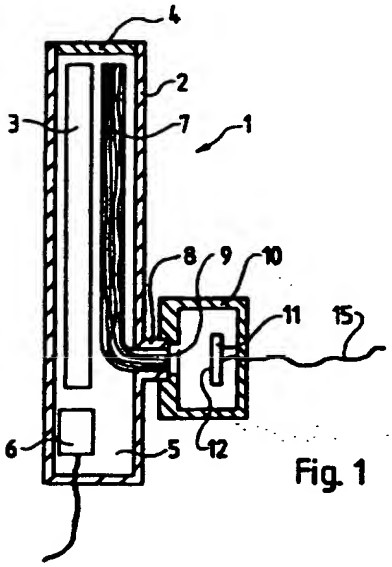

Fig. 1

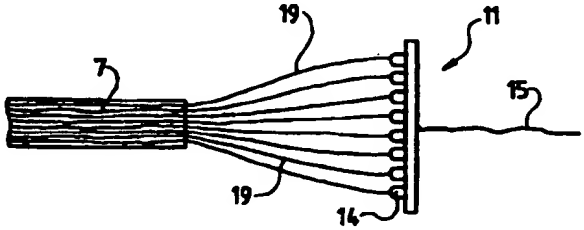

Fig. 4

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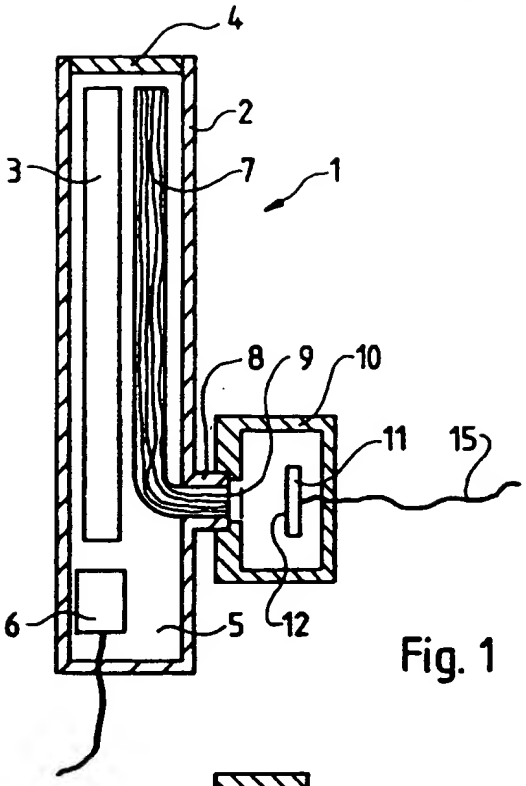

Fig. 1

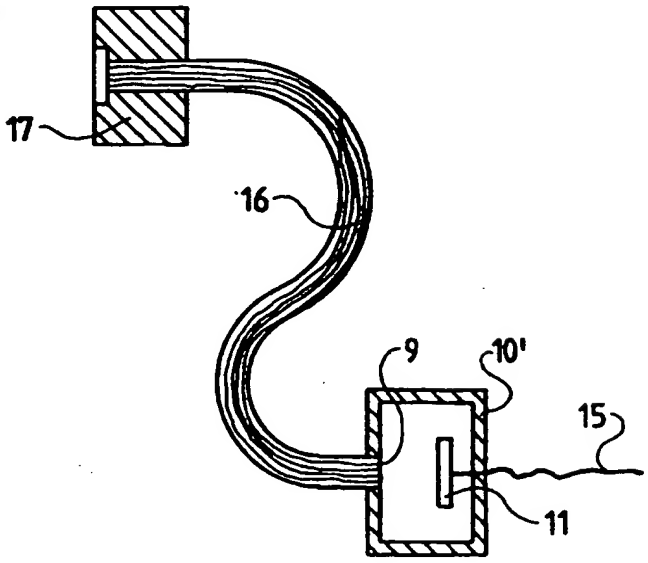

Fig. 2

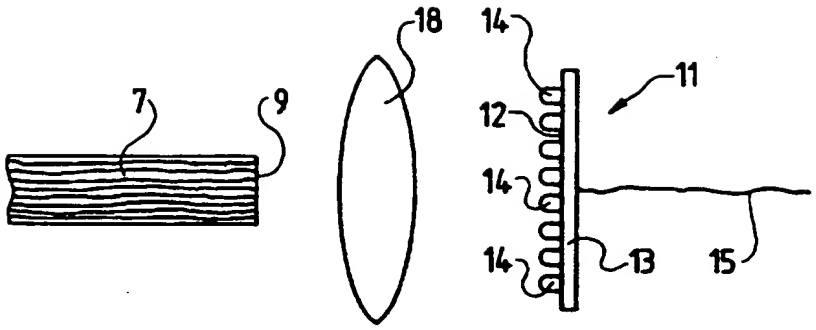

Fig. 3

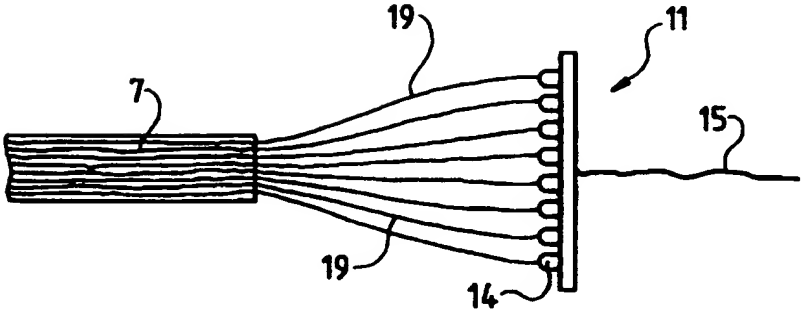

Fig. 4

ILLUMINATED ENDOSCOPES

The invention relates to an endoscope of the type comprising a shaft, through which pass an image guide and a light guide comprising a bundle of optical fibres, and an illumination device arranged to illuminate the proximal end of the light guide.

Relatively old endoscopes had an illumination device in the form of a lamp arranged at the distal end of the shaft to illuminate the field of view seen through the image guide. This was, however, disadvantageous as a result of the space requirement of, and generation of heat by, the lamp. It is thus now common to conduct light from a remote device to the distal end of the endoscope by means of a light guide. The space requirement of a light guide constituted by a fibre bundle within the endoscope shaft can be maintained small and no heat is produced in the endoscope shaft.

In such endoscopes of the type referred to above the lamp is always disposed outside the endoscope and connected to the proximal end of the light guide which passes out of the endoscope shaft. The light guide is generally split into two portions at a light guide connector on the endoscope and extends externally of the endoscope shaft to the lamp, in the form of a light guide extension cable.

Light losses occur in the relatively long light guide. The lamp which is in common current usage is therefore a high power lamp which illuminates the proximal end of the light guide via a condenser lens system.

Of disadvantage with the known illumination devices is the high heat loss which makes cooling devices necessary, and the susceptibility to trouble of the highly thermally loaded lamp, which results in relatively frequent failure of the lamp, which results in problems e.g. in medical operations.

It is the object of the present invention to provide an endoscope of the type referred to above in which the problems of the known endoscopes, particularly the susceptibility to failure of the illumination device are eliminated or at least reduced.

According to the present invention the illumination device in an endoscope of the type referred to above comprises a substantially flat array of a plurality of discrete light sources.

In accordance with the invention an array of a plurality of relatively small light sources or lamps is used and not a single relatively large lamp, as was previously conventional. This provides the advantage of reduced susceptibility to problems since the illumination will substantially continue in the event of failure of one or more individual small lamps. A further advantage results from the possibility of selecting the arrangement or relative positions of the small lamps to produce the desired, e.g. uniform, illumination of the area of the light guide and thus of the field of view of the image guide.

It is preferred that the endoscope includes a condensor arranged to focus the light from the array of light sources onto the proximal end of the light guide. A favourable illumination of the end of the light guide can thereby be achieved, e.g. by means of one or more lenses, which permits the area of the array to be

substantially larger than the area of the light guide. If the light sources are particularly bright, the array can, however, also be arranged directly adjacent or in direct contact with the end surface of the light guide.

The light sources are preferably light emitting diodes. Light emitting diodes have, in particular, the advantage of relatively low heat losses. The result is a lower energy consumption of the illumination device and the necessity of cooling devices is eliminated.

In one embodiment of the invention the fibres of the light guide are associated individually or in groups with respective light sources. The quality of the light transmission from the light sources to the fibres of the light guide can be substantially improved in this manner. The fibres can be secured with adhesive, e.g. in a high quality optical manner, directly to the light emitting surface of the light emitting diodes. A particularly compact construction which is mechanically particularly unsusceptible to trouble is thereby produced.

Since the illumination device in an endoscope in accordance with the invention may require very little space, it can advantageously be positioned on a light guide connector, which is provided on the endoscope shaft.

Further features of the invention will be apparent from the following description of certain embodiments of the invention which is given by way of example with reference to the accompanying schematic drawings, in which:-

Fig. 1 is a longitudinal sectional view of an endoscope with an illumination device in accordance with the invention;

Fig. 2 shows an illumination device similar to that shown in Fig. 1 but which is connected, in use, to the endoscope of Fig. 1 with a light guide extension cable;

Fig. 3 is a schematic view of a first embodiment of illumination device, as shown in Fig. 1 and Fig. 2; and

Fig. 4 is a similar view of an alternative embodiment of the illumination device.

Fig. 1 is a highly schematic view of an endoscope 1 with a shaft 2. Passing through the shaft 2 is an image guide 3 which views the field of view through a window 4 provided at the distal end of the shaft 2 with an objective, which is not shown, and reproduces the image obtained in the proximal end region 5 of the endoscope 1, for instance on an eyepiece, which is not shown, or, as shown in Fig. 1, on a video camera 6.

Also passing through the shaft 2 is a light guide 7 in the form of a bundle of optical fibres which illuminates the field of view through the window 4 with light radiating from its distal end and terminates at its proximal end with an end surface 9 within a light guide connector 8 in the form of a spigot or socket projecting laterally from the proximal end region 5 of the endoscope 1.

Fig. 1 shows an illumination device 10, which is push-fitted onto the light guide connector 8 and in which there is a substantially flat array 11 of discrete electrical light sources which illuminates the end surface 9 of the light guide 7 with its substantially planar illuminating surface 12.

However, as shown in Fig. 2, an illumination device 10' can be provided remotely from the endoscope 1, the array 11 illuminating the end surface 9 of a light guide extension cable 16 which constitutes an extension of the light guide 7 and may be plugged onto the light guide connector 8 by means of a plug 17.

Fig. 3 is a schematic view on an enlarged scale of the construction of the illumination device 10 or 10'. It has a a circuitboard 13 which is provided on its illuminating surface 12 with small lamps in the form of light emitting diodes 14. They are supplied with electrical power by a common power supply, which is not shown, via a connecting line 15. It may be seen that the array 11 illuminates the end surface 9 of the light guide 7 with its light emitting diodes 14 via a condenser 18 in the form of a focussing lens. If the light emitting diodes have a sufficiently high illuminating power and are closely packed on the circuitboard 13, the area of the array can be so small that the array 11 can be disposed directly in front of the end surface 9 of the light guide 7 without using a lens.

Fig. 4 shows a modified construction of illumination device which includes an array 11 of light sources similar to that illustrated in Fig. 3 but in which the light sources cooperate in a different manner with the light guide. The fibres 19 of the light guide 7 are individually connected to respective light emitting diodes 14, e.g. by optically translucent adhesive. Small bundles of e.g. 10 fibres can also be connected to respective light emitting diodes 14. This results in particularly loss-free light transmission.

The array 11 is shown only from one side in the drawings. When viewed in

plan, the individual light emitting diodes 14 may be arranged, for instance, in concentric circles or in a rectangular line and column configuration. Other configurations are also possible, e.g. elongate shapes, though the shape and arrangement of the light emitting diodes in the embodiment of Fig. 4 is of only secondary significance. The shape of the array can be matched also in the embodiment of Fig. 3 to that of the end surface 9 which can, for instance, be of rectangular shape and cooperate with a rectangular array.

Instead of the illustrated light emitting diodes, other small lamps of high illuminating power can be used, such as small plasma lamps. Lamps of different light coloration can also be used, whereby, for instance, white light or light of a suitable colour necessary for the application in question is produced by mixing small lamps of different basic colours.

CLAIMS

1. An endoscope including a shaft, through which pass an image guide and a light guide, comprising a fibre bundle, and an illumination device arranged to illuminate the proximal end of the light guide, the illumination device comprising a substantially flat array of a plurality of discrete light sources.

2. An endoscope as claimed in Claim 1, including a condensor arranged to focus the light from the array of light sources onto the proximal end of the light guide.

3. An endoscope as claimed in Claim 1 or 2 in which the light sources are light emitting diodes.

4. An endoscope as claimed in Claim 1, in which the fibres of the light guide are associated individually or in groups with respective light sources.

5. An endoscope as claimed in any one of the preceding claims including a light guide connector on the shaft, the illumination device being connectable to the light guide connector.

6. An endoscope substantially as specifically herein described with reference to Figure 1 or Figure 2 in combination with Figure 3 or Figure 4 of the accompanying drawings.

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Applicati n N : GB 9914608.6
Claims searched: 1 - 6

Examiner: Andrew P Jenner
Date of search: 16 November 1999

Patents Act 1977
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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): G2J: JB7R4, JE, JGCB1

Int Cl (Ed.6): G02B

Other: Online: World Patents Index, Epodoc, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 95/15060 A1	APOLLO CAMERA L.L.C. - see figure 1, page 2 lines 28 - page 3 lines 1 - 3	1 at least
A	US 4562831 A	FUJI PHOTO FILM CO. LTD - see figure 1	

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